THE

SCIENTIFIC ALLIANCE

—OF—

NEW YORK.

COMPRISING THE MEMBERS OF

THE NEW YORK ACADEMY OF SCIENCES,
THE TORREY BOTANICAL CLUB,
THE NEW YORK MICROSCOPICAL SOCIETY,
THE LINNÆAN SOCIETY OF NEW YORK,
THE NEW YORK MINERALOGICAL CLUB,
THE NEW YORK MATHEMATICAL SOCIETY,
THE NEW YORK SECTION OF THE
AMERICAN CHEMICAL SOCIETY.

ADDRESSES

DELIVERED AT THE

FIRST JOINT MEETING,

HELD AT THE

AMERICAN MUSEUM OF NATURAL HISTORY,

Tuesday Evening, November 15th, 1892.

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Officers of the Council, 1892-1893.

PRESIDENT: CHAS. F. COX,
Grand Central Depot.

SECRETARY AND TREASURER: N. L. BRITTON,
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NOTE.

The first Joint Meeting of the Societies forming the Scientific Alliance of New York had for its object the public presentation of the needs of science in this city, and the plans and purposes of the Council of the Alliance. This Council is composed of the President and two other members of each of the organizations and has advisory powers only.

The membership of the societies is over 650, and includes nearly every name of persons especially interested in Pure Science in New York.

The following addresses present an outline of what the Council is endeavoring to accomplish, and its members will welcome any suggestions or correspondence on the matter.

ADDRESS OF HON. SETH LOW,

PRESIDENT OF COLUMBIA COLLEGE,

ON THE

ADVANTAGES TO NEW YORK CITY OF THE ALLIANCE OF THE SCIENTIFIC SOCIETIES.

Ladies and Gentlemen: It will be noticed that I am to speak of the advantages to New York, to the city itself, that may reasonably be expected to spring from the affiliation and coöperation of the societies, in other words, I assume, from the Scientific Alliance. New York is a great commercial city and a great financial centre. New York has in it also, at the present time, many scientific men of the first order. Here has been done, in the past, the work of Draper and of Morse, the work of Rutherfurd and of Newberry and not a little of the work of Edison. Yet New York is not a great scientific centre, in the same sense that it is a great financial centre. The desire of the Scientific Alliance is to make the city a great scientific centre, in the sense that the city shall become a positive power in the world of scientific thought and action. I need not pause, at this moment, to dwell upon the advantages to this city if that expectation shall be realized. Let me rather point out the way in which, I think, this result may be reached.

New York is a great commercial and financial city. New York has its Produce Exchange, its Maritime Exchange, its Stock Exchange, and many other exchanges; and New York has its Chamber of Commerce. The exchanges are organizations to facilitate business; the Chamber of Commerce is the great representative body of all the business and financial interests of the city. No business is transacted on the floor of the Chamber, and for this very reason it can serve as the common meeting ground of every business. When the Commerce of New York is appealed to on its philanthropic or its patriotic side, the Chamber is its natural organ. The Chamber col-

lects and prints statistics of a general character, as distinguished from the daily bulletins of the exchanges. In a word, it is the representative of the business community as distinguished from any particular trade or industry. In asking your attention to this condition of things, I do not pretend for a moment that New York is made a great commercial city by its exchanges and its Chamber of Commerce. These rather exist because New York is a great commercial centre. Yet it is certainly true that the exchanges and Chamber do powerfully contribute, by the sense of common interest that they foster and by the facilities they afford, to the maintenance of New York's commercial supremacy. What is significant from the point of view of this discussion is, that if the strong commercial life of the city requires these agencies, so will every interest require them, or something like them, as it becomes strong enough to feel that it can make itself felt and has the desire to do so. It is not unapt to say that the museums, with their staff of investigators, and the colleges and universities of the city correspond roughly to the exchanges, but science in New York is only now beholding the vision of its Chamber of Commerce. This movement towards a Scientific Alliance is at once suggestive of a growing sense of power and of new aspirations on the part of scientific men in the city. If I may venture as a layman, to draw an illustration from the field of electricity, I would point out to you that however much electricity may be present in the atmosphere, it gives no sign of its presence until favoring conditions make it manifest. Similarly there may be, and there doubtless is, a vast amount of scientific knowledge and interest in this great community, but it must have facilities for expression before it can make itself known and felt, still more before it can drive the motors of scientific activity along the paths of investigation and the large service of mankind. Naturally, the city is not wholly devoid of such means of expression. The museums, the universities, the colleges of the city, as I have said, do something to fan the flame, and between them bring into the city probably the largest body of men whose attention turns naturally to such things. Neither is it just to leave out of the account the con-

stant encouragement which business men in New York are extending to those who are endeavoring to apply practically the results reached in the domain of pure science. But beyond the walls of all such institutions, and outside the ranks of inventors, all through the city are men whose tastes and interests incline them to scientific pursuits. All these sorts of men have organized themselves into various scientific societies, each after its kind, to listen to and discuss scientific papers. These bodies have revealed at once the strength and the weakness of New York in these directions. They have made clear beyond a doubt the vast resources of the city, both in men and means. But they have also revealed the fact that these resources are as yet insufficiently organized. They have also made clear that such a movement in New York is beset with at least one difficulty peculiar to the place. The New York audience is itself so large that many men have been content with reaching that audience alone. They have not always realized that the man who wishes to benefit mankind by his service to science must be contended for, like the poet, by many cities. Not even imperial New York should satisfy the ambition of our scientific men; they must seek and deserve a world-wide hearing. Newton read his "Principia" to the Royal Society of London before it was published, and sought their judgment upon it. So it should be here. Many a scientific bubble will be pricked by such a test, but that which is true will be established. Men should seek to say not simply what will gratify the society and never be heard of beyond its walls, but that which, being said to the society, will command attention wherever it is known. All this means that there must be, in the scientific life of the city, such earnestness as will lead to thorough and patient work on which alone scientific renown is based. The immediateness and magnitude of local recognition in the city of New York, I sometimes think, has operated to discourage depth and thoroughness. Men are tempted to speak too soon and too often. The man who has no local audience is perforce silent until he has something to say which will command a hearing at large.

On the other hand, the multitude of such scientific so-

cieties as I have been discussing, dissipates the august audience that New York might afford to its devotees of science, and breaks it up into comparatively unimportant groups. The scientific spirit, in a word, lacks intensity of expression. Our neighboring city of Brooklyn, through the strength that has come to it by the association of its lovers of science of every name in branches of the Brooklyn Institute of Arts and Sciences, has opened and maintained a successful seaside laboratory of Biology at Glen Cove. Our resources in men and means are vastly larger, but they have not so early been turned to account. Scientific expeditions go out from smaller cities with a frequency not equalled here, although it is pleasant to make note of the activity of the American Museum of Natural History, in this regard.

The Scientific Alliance of New York has the capacity, I think, to give to New York the agency which the city has long needed to develop to the utmost its scientific activities in the direction of pure science. First of all, the Alliance conforms to that fundamental truth of modern scientific thought, the unity of nature. We recognize that all sciences, so called, are only branches of one all-embracing science. They belong together and not apart, because they are mutually interdependent. But this Alliance needs, for the full accomplishment of its designs, a common home in which the different societies shall have their headquarters, use their libraries in common, and make available for all the periodicals and meetings of each. Such a building should contain accommodations for a truly great scientific library, and a lecture hall that might be turned to account for the instruction and enlightenment of the public. It would naturally become the place where scientific men "most do congregate." With an agency of this kind at its command, adequately supported, it would be but a short time before the Scientific Alliance of New York would awaken in the city a veritable enthusiasm for the encouragement of scientific research. It should offer the means of publishing meritorious papers, and it should fit out and maintain scientific expeditions to all parts of the globe. In this way it would do much to make New York a benefactor of the nations, one of the cities

the world would not willingly let die. It is a significant commentary, I think, on the situation of the moment, that a gentleman living on Long Island who wished to contribute something to the advancement of science should have recently given $100,000 to the Royal Institution of London. The same getleman, wishing to give something to charity, was able to find satisfactory agencies in New York. How long shall it be before men who are like-minded shall find in New York some worthy peer of the Royal Institution of London dedicated to the advancement of scientific inquiry and research?

But, perhaps you ask me what, after all, will be the value of all this to New York, if it should get it? One might give many answers, but I prefer rather to ask: What is the value of light to the sun, of poetry to the poet? Only that light reveals the nature of the sun, and poetry the nature of the poet. This city will surely be a nobler and a better place to dwell in, the more it can draw to itself, and make happy and useful within its borders, the men who question nature for her secrets and reveal them for the service and advancement of mankind.

ADDRESS OF MR. CHARLES F. COX,

ON THE

ADVANTAGES OF THE ALLIANCE TO THE SCIENTIFIC SOCIETIES.

The hopeful words which have been spoken by President Low surely leave no room for doubt that the alliance of the scientific societies of New York is destined to accomplish good in at least one direction. But the arrangement of topics upon our programme indicates that this is only part of the result expected from the movement which we have met to promote, although, in the light of the convincing presentation of the matter which we have just heard, we may indeed look upon it

as the major part of the work we have before us. For myself, I shall regard the union of the organizations which we represent as already justified, if we are able to fulfill, in even moderate measure, the prophecy which has been so confidently made for us. According to the encouraging horoscope which President Low has cast, it is to be our good fortune to exert a beneficent influence upon the development of the great metropolis in which we dwell, and, at the same time, by the very enlargement of our aims, to give a new impetus to scientific progress. But this is not bespeaking for us a simple and an easy task. We need, at the outset, to recognize the fact that we have embarked in an undertaking calling for an unusual amount of energy, earnestness, persistency and faith. But these qualities are not to be brought into existence merely by banding ourselves together. Men do not create capital by forming business partnerships. They make up their firms because they have already a surplus of means and wish to increase them by putting them to the largest possible use. So, if these societies are to make themselves felt in the efficient manner predicted by President Low, they will do so because they are themselves animated by a vital force more than sufficient to keep their own internal functions in operation. If it had not been believed that they had reached this point in their development, this Alliance would never have been formed.

According to the late Dr. Drysdale, the fundamental criterion of vitality is in the reaction of ultimate anatomical units against their environment. On this principle we propose to test the energy of these organizations by bringing them into closer contact with the restless, eager, busy world about them, confident that, even if the extrinsic effects produced turn out to be but barely appreciable, there will still prove to be intrinsic results more than compensating for the efforts put forth. At least the cause of science will be honored by our devotion, and the pursuit of pure truth will be exalted and set before the people as an example of the things which moth and rust do not corrupt—as something, therefore, in this age of business and bustle which is rather to be chosen than great riches.

If Dr. Drysdale's criterion will stand the experimental test

to which we shall thus put it, we shall find that our endeavors will inevitably produce within our societies a correlative development of vigor and productiveness by which they will rise to higher and higher possibilities and reach out after nobler and nobler purposes. Each determined attempt we make to broaden the boundaries of learning will at least deepen our own appreciation of knowledge. Each serious plea we put forth for a higher standard of education will lengthen the rule by which we measure our own achievement. And thus, as Emerson says, "every act rewards itself."

Therefore I place above all other advantages which the scientific societies of New York will derive from this alliance, the stimulating and reënergizing effect which will be wrought in them by the demand made upon them for an increased output of effort for the public good. I verily believe that in proportion to the new duties conscientiously assumed will be the increase of capacity, not only for their performance, but also for self-development. So long as our societies are merely self-contained they possess only what we used to designate, in a paradoxical way, as latent energy. In their separate existences they are like the disconnected cells of a storage battery; the elements of power are there and arrangement of the parts is theoretically admirable and interesting, but there is little activity, and what there is is merely the inefficient result of "short-circuiting." To get work of any great value we must bring the cells together in a close bond of intercommunication and then focus their combined strength upon something worth doing; we must set them a task large enough and important enough to draw upon their innermost resources and to stir every constituent particle to its widest range of movement. Thus harnessed to a definite purpose, the battery will evolve propulsive force in proportion to the call made upon it to overcome inertia and friction.

This reference to the necessity for linking the several cells together, so that they may contribute to a single working current, leads to the consideration of another advantage which these societies are to derive from this alliance. This is the reënforcement and encouragement they and their members will receive

from contact with one another, through sympathy, advice and example. In these days of rigid specialization, when the constantly expanding domain of science has become by force of circumstances cut up into more or less independent states and territories, confederation, for aid and defence, has become as much of a necessity as it was to our early colonists after they had once attained to local permanency and vested interests. Science has taken possession of a vast world of previously uninvestigated phenomena since Columbus first crossed the Atlantic, and it requires absorbing labor in many scattered regions to fell the dense forests of ignorance and fill up the low places of superstition. Investigators of Nature's laws are not now beset by the same sort of enemies as those who harassed the truth-seekers of Columbus's time, but you men of science have none the less your foes. Strange to say, the most powerful of these are your opponents unconsciously. They are the average mass of men about you, wholly devoted to self-seeking and swallowed up in the struggle for material aggrandizement. They measure knowledge by commercial standards and have put a market value even upon truth. Your science, in their eyes, is worth only what it will bring when offered in the form of dynamos, telephones, electric lights, dye-stuffs, mining machinery, and other merchantable wares. These are the real materialists—the worshipers of the pound weight and the foot rule. It is they who are responsible for the current sarcasm aimed at "theorists and doctrinaires," though they are not wholly a product of our time. Henry Crabb Robinson tells us, in his extraordinary diary, that when the great Humboldt returned to Europe from his honorable and successful expedition to South America, and was presented to the first Napoleon, the haughty warrior received the modest explorer and discoverer with the remark: "You are a lover of botany?" "Yes," answered Humboldt, proud of the service to which he had devoted his life. "So is my wife," curtly rejoined the conceited Emperor, dismissing at once the humble man of science and his belittling pursuit. Somewhat in the same vein, though with a very different application, is an experience which befell me in my days of youthful enthusiasm when, upon a first visit to

Washington, some kind friend favored me with an introduction to the late Prof. Baird. I carried my letter to the Smithsonian Institution with high expectations of the pleasure to be derived from the interview I was seeking. The note was responded to promptly by Prof. Baird, who came from his laboratory into the museum to meet me. His greeting was much like Napoleon's, and I suppose I may say truthfully that, until the completion of the colloquy which I am about to relate, I felt fully as important as Humboldt did during his presentation at the French Court. "So you are fond of natural history?" the Professor inquired of me. "I think am," I diffidently replied. "The reason I ask," he continued, "is because women and children and weak-minded persons are usually those who are fond of natural history." It did not occur to me then to wonder in which of these classes the Professor himself claimed membership, but I remember now that his face bore a peculiar expression which I think might have been interpreted to mean, he who devotes himself to the study of nature needs to beware of the jibes of those who can not understand the pursuit of truth for truth's own sake.

Although this warning is not as needful as it used to be, and although it is likely to be still less necessary as time goes on, you disciples of pure science should fortify yourselves in every way possible against these contemners of the impractical. But, of course, there is no safety in mere seclusion. We live in an era of ceaseless activity, in which the principle of natural selection operates quickly to eliminate those who refuse to struggle. This is also an age of coöperation and consolidation, and we shall find it advantageous to follow in the path of worldly wisdom to the extent of adopting a mild form of communism. I have no doubt it will prove to be a case of protective mimicry, and it may even turn out to be the means of our preservation as societies, to put into a common stock for the general good not only whatever of knowledge, ability and energy we possess, but also all the enthusiasm, devotion and hopefulness with which we happen to be endowed. Thus shall we best help one another to stem the discouraging current of utilitarianism which is ever dragging capable men away

from the firm anchorage they might find in meditation, study and investigation.

But while I plead for what Carlyle calls *the Everlasting Yea*, "wherein whoso walks and works, it is well with him," I see that we cannot wholly escape the necessity for considerations of self-interest and self-preservation. But the profits we reckon up are not the profits of dollars and cents. The saving we expect to effect is not that of material substance, but rather the economy of time and thought. Scattered as we are over the broad field of research, we require facility of intercommunication for the sake of acquaintance with one another's achievements, so that what one man has done need not be done after him. Life is too brief to be spent in duplicating work already accomplished, and never were the sciences so dependent upon one another as they are to-day. In fact, all investigation seems to be converging upon the philosophy of the molecule and the atom. The anthropologist and the ethnologist have to call in the biologist and the histologist to help trace human action to its mysterious beginnings in the living cell. The biologist must apply to the chemist for an analysis of his so-called "physical basis of life," and not only have the departments of inorganic and organic chemistry gradually merged into each other, but their combined resources are now turned toward the synthetical production of not alone organic substances, but even living matter. So would the chemist turn biologist. On the other hand, the physicist is extending his boundaries into the domain of chemistry and will before long claim the whole region, on the ground that all chemical action can be reduced to atomic motions and attractions. Geology, we all know, is as much a matter of zoölogy and botany as it is of petrology, and both geology and mineralogy long ago discovered their foundation in chemistry and physics. Conversely, the zoölogists and the botanists are compelled to be geologists and geographers, while all sooner or later get round again to ethnology and archæology. Botany, particulary in its latest development in the direction of fungology and bacteriology, has become inextricably tangled up with chemistry, and even with physiology, medicine and path-

ology. The astronomer, too, finds himself forced into close relationship with both physics and mathematics, and as for the mathematicians, they have about exhausted the possibilities of pure number and have cast in their lot with those who deal with masses and forces. Indeed, we may look upon them as the nexus between the purely physical and the purely rational, or perhaps some would prefer to say the *ir*-rational, since they have driven us nearly crazy with their unthinkable abstractions concerning one-dimensional, two-dimensional, and four-dimensional space.

All these examples merely illustrate the interdependence of the different departments of modern science and the necessity that exists for the economy of mental labor. It is no longer possible for the various branches of learning to exist in scattered and isolated centres. Such an arrangement is in itself unscientific, because it is both inefficient and wasteful. What we propose to do through this Alliance is to furnish the scientific societies of New York a common ground to stand upon, and eventually something that we may rightfully call "rapid transit" for thought and knowledge. We shall hope to accomplish this not simply by supplying one organization with information of what is done in another, and so preventing the profitless threshing of old straw, but mainly by bringing to light those subjects upon which a union of forces will produce the best results. For the immediate present, we shall probably find the most promising field for concentrated effort in the presentation of the claims of science to the consideration of the better educated portion of the community, with a view to enlisting sympathy and assistance in the work of establishing it upon a basis comparable with that of any other of the elevating and refining agencies upon which our people bestow an appreciative patronage. Religion, organized benevolence, the fine arts, literature, general education, and even technical training, receive generous and well-merited support and encouragement. We learn with pride and pleasure of the promising movements for a stately cathedral and noble college halls to crown the heights above Central Park; it is with deepest gratification that we behold the erection of the beautiful and ap-

propriate buildings which a broad-minded liberality has just bestowed upon the United Charities and other humane associations, upon the new Fine Arts Society, and upon the whole mass of music lovers in our midst; and it is with hearty rejoicing that we hear of each addition to the valuable collections of our great public libraries, and of every new contribution to the superb treasures of our worthy Museum of Art. And in this list of our city's refining agencies let us not forget to include the splendid institution to whose hospitality we are indebted to-night—under whose roof it is our privilege to take the first public step in the important project to which we have committed ourselves and our societies. It, too, has been a recipient of the people's favor and approval, though it has repaid ten times over all that has been bestowed upon it, and stands forth to-day a prominent example of the profitableness of the investments which the community is making in institutions for popular education. This result is all the more satisfactory because this is essentially a commercial community, accustomed, as I have already said, to appraise even knowledge according to the return it makes upon the capital expended in its acquisition. But at last this very "practical" city is beginning to realize that all profit is not necessarily in kind—that an outlay of money may produce a purely moral and intellectual income of great value; and the recent manifestations of public spirit which I have cited are evidence that we are in the midst of a local renaissance from which our societies cannot fail to receive great benefit. As I have shown, much has been, or is being done for almost every sort of philanthropic enterprise; but as yet pure science, the science of research, has failed to share in this revival of liberality. Illustrative science we see tolerably well provided for in this finely equipped museum, but this objective side of science should be supplementary to the more subjective side which we represent, and the two phases of one division of learning should go together and receive each its proportionate degree of patronage and support. Although our turn may come last, it surely will come, and at no very distant day. With a view to the outcome which we trust we already behold materializing, this Alliance has not been formed

a moment too soon. I trust that it is apparent from this gathering to-night that we are prepared to give an impressive account of ourselves and to sustain the claim of this organization to be considered one of the important uplifting forces in this crowded centre of life and activity. To just what uses we propose to devote the means which we confidently expect to receive, will be told you by the speakers who are to follow. They will set forth our hopes for a much-needed endowment of original research and publication; our plans for the foundation of a distinctively scientific library, now wholly lacking; our eager readiness to assume a part in popular educational work, still incomplete and capable of extension; and our desire and aspiration for the possession of an edifice in which all these societies shall be properly and adequately housed; a building which shall stand as another permanent reminder to this excitably energetic people that knowledge is, after all, the most trustworthy source of power; which shall be to this nervous and restless community a new source of calming and tranquilizing influence. These objects we shall certainly accomplish in due time if we persevere with firm faith and steadfast purpose, and, having accomplished them, we shall find that these societies have derived advantages from this Alliance just in proportion to the sincerity and self-devotion with which they have sought to confer advantages upon the magnificent city which it is our pride to call our home and, through it, upon the general cause of science throughout the world.

ADDRESS OF HON. ADDISON BROWN,

ON THE

NEED OF ENDOWMENT FOR SCIENTIFIC RESEARCH AND PUBLICATION.

Twenty years ago Prof. Tyndall delivered in New York and in other cities of this country a series of lectures upon light. The last of the series was an impressive plea for a more thorough prosecution of original *research* in pure science; and incidentally, for the need of *endowments* to maintain it. I was fortunate in having the opportunity to listen to that remarkable course of lectures and to that plea for science. Its impression has never left me. The impression was the deeper, because Tyndall set upon it the seal of self-denial. Some $30,000, nearly the entire net proceeds of his lectures in the United States—money for which he undoubtedly had abundant use in his own affairs, or at least in the prosecution of researches in his own country, and which by all precedent and the example of other lecturers he would have taken with him—all this he has given to the science of this country, endowing therewith, in 1885, three scholarships for the prosecution of original research in physics, one under the direction of Columbia College, one under Harvard, and a third at the University of Pennsylvania.

The truths uttered and the example set by this self-denying master have already many times borne fruit. The late President Barnard, of Columbia College, who was a warm supporter of Prof. Tyndall when here, bequeathed to Columbia upon his decease a few years since, the sum of ten thousand dollars for the endowment of *another* fellowship, for the encouragement of scientific research, upon substantially the same terms as those of the Tyndall Scholarships. In other parts of the country there have been some other endowments for similar purposes. In the last year Columbia has also received one hundred thousand dollars, the munificent bequest of Mr. Da Costa, for the establishment of the department of biology. Although this bequest is not primarily for the prosecution of original

research, it is not restricted by hampering conditions, and will to some extent, it is hoped, admit of a direct and continuous support of the highest and most advanced studies.

The appeal made by Tyndall has been often renewed by scientific men; by the heads of universities; by the presidents of scientific associations, here and abroad; and by none, perhaps, more eloquently than by Dr. Edwin Ray Lancaster, in his address before the biological section of the British Association at Southport, in 1883.

What shall we say to the call and the examples of such men? Was the gift of Tyndall based only upon an idle fancy? Or was it the result of a clear perception of a profound truth, viz: America's need of that money as a stimulus and support to more scientific research; the call on him being felt to be the more imperious, because the need of it was so plain to him, while obscure to others; and making his act, therefore, a noble instance of self-renunciation in an unappreciated cause?

"To keep society as regards science in healthy play," he says, "three classes of workers are necessary:"

1. "The investigator of natural truth, whose vocation it is to pursue that truth and extend the field of discovery for truth's own sake, without reference to practical ends;

2. "The teacher, to diffuse this knowledge * * *

3. "The applier of these principles and truths to make them available to the needs, the comforts or the luxuries of life * *

"These three classes ought to co-exist and interact. The popular notions of science * * * often relate, not to science strictly so called, but to the application of science."

The great discoveries of scientific truth, he continues, are "not made by practical men, and they never will be made by them; because their minds are beset by ideas which, though of the highest value in one point of view, are not those which stimulate the original discoverer."

In a chance conversation, a few weeks since, I received a confirmation of these words, so direct and unexpected, that it may bear citation. I was talking with an electrical expert who had made several very interesting and important inventions. I asked him of how much importance he conceived that the

scientific men of the closet, the original investigators so-called, had been in working out the great inventions of electricity during the last fifty years,—the telegraph cables, telephones, the electric lighting, and the electric motors; and whether these achievements were not in reality due, mainly, to the practical men, the inventors, who knew what they were after, rather than to the men of science who rarely applied their work to practical use?

"Not at all," he said, "the scientific men are of the utmost importance; everything that has been done has proceeded upon the basis of what they have previously discovered, and upon the principles and laws which they have laid down. Nowadays we never work at random. Look at that electric light! Of the energy expended in producing it, only 7 per cent. appears as light; the rest, 93 per cent., is wasted, mainly in heat. We are all now trying to prevent this enormous waste. I want to reverse that proportion; but if I can reduce the waste to only 33 per cent. a patent of my invention will be worth millions of dollars for its economy in production. In seeking this we do not work at random. I go to my laboratory; study the applications of the principles, facts, and laws which the great scientists like Faraday, Thompson and Maxwell have worked out, and endeavor to find such devices as shall secure my aim."

This is but an expression, in another form, of what Tyndall said twenty years ago:

"Behind all our practical applications, there is a region of intellectual action to which practical men have rarely contributed, but from which they draw all their supplies. Cut them off from that region, and they become eventually helpless."

What is true in one department of natural science, is, I apprehend, equally true in all.

The practical men do not work at random, but upon the basis of what scientific research and publication have previously put within their grasp.

It is evident, therefore, that not only the advancement of knowledge itself, but all possibility of any continuous advance

in those great improvements which are to mitigate the sorrows, and promote the health, the conveniences and the comforts of men, is vitally dependent upon the progress of scientific research. In recent years how marvelous have these improvements been! Besides those that are most common and familiar to all, what miracles almost have been achieved through the photograph, the spectroscope, the microscope; by the discovery of the sources of fermentation and of putrefaction; by the discovery of anesthetics and the application of antiseptic methods in surgery, and in the treatment of other lesions. These latter discoveries alone have ameliorated beyond expression the sufferings of man; they save more lives than war and pestilence destroy, surpassing even in that regard the safety lamp of Sir Humphrey Davy—an invention which, at the time it was made, was said to have exceeded every previous discovery as a means of saving human life, except, possibly, inocculation for smallpox.

This vital relation between the advancement of knowledge and the welfare of man furnishes an all-sufficient reason for the continuous and never-ending prosecution of original research. Of necessity the original work of *discovery* must always lead; that must always precede the practical applications. The necessity for such research must, therefore, continue, so long as science and human society endure. As there is no limit to the advance of knowledge, so there can be no limit to the benefactions it is capable of conferring upon mankind. The more rapid the advance, the more speedy the enjoyment of its fruits. In this relation alone, the need of ample provision for scientific progress is one that addresses itself equally to the nation, to the state, to philanthropists, and to all who would advance the welfare of man, on the broadest and most enduring lines.

How shall such research be maintained and extended? The investigator of pure science does not work for profit. His discoveries are not marketable. The law allows no patent upon a principle of nature or the discovery of a new truth. Newton could not patent the law of gravitation, nor Volta the galvanism of the voltaic pile; nor Ehrenberg and Schwann, the discovery

of the widespread influence of bacteria; nor Faraday, nor Henry, electro-magnetism; nor Joule, his correlation of forces; nor Jackson, his anesthetics; nor Lister, his antiseptic treatment; nor Koch nor Pasteur, their discoveries of the bacilli, the destruction of which may lead to the cure or amelioration of terrible diseases. To the practical men and to the inventors, on the other hand, who apply to the specific wants of men the truths and principles which the scientists have made known to them, the law, in the form of a patent, gives a monopoly of from fourteen to twenty-one years. They thus obtain, as a rule, a reasonable, and, in some cases, even an excessive, pecuniary reward. In this country alone nearly 500,000 patents have been issued; they are increasing at the rate of about 25,000 per year. In the extreme multiplication of patents affecting a large part of everything we use, the whole world, it might almost be said, is paying tribute to the inventors and practical men; while to the original discoverers who have made so much of all this possible, there is no promise of pecuniary reward.

This is not said by way of complaint. In the nature of things, it is scarcely avoidable. The aims, the motives, the methods and the genius of the two classes of minds, are and ever must be widely distinct. Original discoverers cannot be turned aside from their special work to become mechanics and inventors, without infinite loss. Prof. Henry had one form of the electric telegraph in actual use some years before Morse conceived it.* But how great would have been the loss to science, without any corresponding gain, had Prof. Henry in 1830 turned away from pure science, to do the subsequent work of Morse in adapting the telegraph to common and valuable use!

Research in pure science can never be made a self-supporting pursuit. It can never, therefore, be carried forward broadly, and continuously, and effectively, except through men sustained by some form of stipend or endowment. Occasionally, it is true, men of independent fortune, like Harvey and Darwin

* Smithsonian Report, 1878, pp. 159, 262.

and Lyell and Agassiz, have devoted themselves to original research upon their own means, and have accomplished most important results. But these instances are rare. Many other persons, too, with aptitudes and tastes for research, though not following a scientific career, have carried on private researches in the intervals of leisure, stolen from the exacting demands of professional or business life; and these have, in the aggregate, added no small amount to the common stock of knowledge.

It is no disparagement, however, of these subordinate workers to say, that nearly all the great discoveries, and nearly all the great advances along the lines of knowledge, have been achieved by men who in the main have devoted their lives to the work, and have been supported through institutions or endowments which made this devotion possible. Government appointments, professorial chairs, or salaried positions in scientific institutions of some kind, have been and must continue to be, our chief dependence. And it is manifest that these can only be maintained by Government aid, or by the bounty of private individuals. The former is mainly the European system; the latter, in the main, is ours. There, universities are founded by the government; here, chiefly by the people.

In Germany there are twenty-one universities maintained by the government. In each of these, as Dr. Lancaster states, there are five independent establishments in the Department of Biology alone, viz: In physiology, anatomy, pathology, zoölogy and botany. At the head of each of these establishments there is a professor, with two paid assistants, making altogether about 300 for biological research in Germany; and he estimates about one-quarter of that number in the same department in England. In all the sciences, therefore, there would probably be found in Germany from 800 to 1,000 persons of high scientific attainments, supported by the government in the universities, who are regularly and systematically engaged in the discovery of new scientific truth. For it is there made both the object and the *duty* of the professors of natural science, to carry on original investigations by work in the laboratory. Their positions are obtained through previous distinction in such investigations; and it is for this work that their small but fixed stipend is paid by the government.

In the College de France, also maintained by the government, there is the same requirement, though with a larger salary to the professors, and with the added duty imposed on them to deliver to the students about forty lectures yearly upon the subjects of the professors' researches; while in Germany the professors also receive from each student who attends their lectures, a moderate fee, which serves to increase their meagre stipend, as well as to stimulate their activity and usefulness. Under this system, Germany has become the greatest school of science, and the resort of the whole world.

In this country the opposite system prevails. The colleges and universities are mainly private foundations, dependent on private gifts and endowments. The colleges are unwisely multiplied. All are more or less cramped for money. This limits the number of professors and assistants appointed for instruction, and crowds them with routine work. The result is that in all but a few colleges, and in these until comparatively recently, the duties of instruction have left to the professors but little time or opportunity for the prosecution of original investigations; and these with but poor equipment and inadequate means.

In not one of all our colleges and universities, so far as I have been able to ascertain, is there a single professorship endowed or founded, even in part, for the *avowed object* of original scientific research. Instruction, not discovery, is the only avowed object. It is to the great credit of American professors and teachers that, with so much routine work on their hands, and so little leisure for research, they should have accomplished by purely voluntary studies so much as is shown in their contributions to our scientific publications.

To what is said above, perhaps a virtual exception should be made as respects our astronomical observatories, in which, the labors of instruction being less, original work has been, perhaps, expected, and has been accomplished with most signal success. To some extent this may possibly apply to our medical schools also. And in other departments, generally, wherever time and opportunity have been afforded, much original work has been done by our professors; some of it of the first class. This is

attested, not to mention living instances, by the work of Prof. Henry at Princeton, Dr. Torrey at Columbia, Dr. Silliman at Yale, Dr. Gray at Harvard, and many others that might be named. In a number of the States, also, and at Washington, there have been maintained by the State or Nation a number of scientific men, in connection with certain State or National interests, who have accomplished most important results; of these, Dr. James Hall, of this State, is a conspicuous instance. At Harvard and at other colleges some noble opportunities for special study have been also provided in their scientific schools and museums; notably in the Zoölogical Museum, the Jefferson Physical Laboratory, and the Peabody Museum of Archæology at Cambridge, and also in the Department of Hygiene at the University of Pennsylvania. But in most of these the great complaint is the lack of necessary endowments to make possible the active advanced work in original discovery for which those institutions are designed. In the Peabody Museum there was in 1891 a gift of $10,000 by Mrs. Hemenway to establish a post-graduate Fellowship; and also a gift of like amount by Mr. Wolcott, for the general support of the museum's work. New York also has within a few years past seen spring up almost as by magic, through the efforts of a single leading spirit, seconded by other public spirited men and women, and by municipal aid, a Museum of Natural History that bids fair to stand in the front rank of scientific opportunities; but the endowments of fellowships and professors necessary to make its opportunities available in active research, are as yet wanting.

England holds a position midway between the United States and Germany. Her scientific men lament her deficiencies. They are striving to increase their means for scientific work, and are doing so yearly.

If experience teaches anything, it is that no broad and general development of scientific work of the first class is possible, except either through independent establishments for special work; or else by the university system, in which professors in science and their assistants are first selected on account of their previous distinction in original research, and are then appointed to *continue that work*, and in the teaching of students, to trans-

mit to *them* the zeal of discovery and the true methods of advance.

It matters little whether the support of the university or of special institutions for research comes from the government or from private endowment, provided the provision is adequate and constant. The difficulty with us has been, and still is, that funds are insufficient, the means and equipment inadequate, and the time allowed to the professors for research insufficient. There has been too much of the schoolmaster, and too little of the real professor. Too great absorption of the professor's time in the work of instruction is injurious to both teacher and pupil. The most stimulating of teachers is he who by daily experiment is in vital touch with Nature; he who brings from the fires of the laboratory the warmth, the illumination and the inspiration of his own researches.

This is now well recognized; and, so far as their means will permit, the leading colleges are by degrees relieving their professors of the work of elementary instruction, so that they may the better prosecute original researches, and at the same time become best qualified for the highest work of instruction. This system will, doubtless, demand watchfulness and discrimination. To prevent abuses, regulation and responsibility may have to be imposed. But it involves the appointment of additional instructors. It requires added means. And this is indispensable as a part of the transition of our leading colleges to the university system. It is indispensable, also, if we are to have in this country any considerable systematic prosecution of original research. We must use existing instrumentalities and existing institutions. And all experience shows that outside of the few government positions, and in the absence of special institutions for research, the professorial chairs are best adapted to such investigations. No greater service could be done to science than to make such endowments as should insure systematic and continuous research by the professors as a part of the new university system.

Endowments for the same object, and operating in the same line, might also take a different form, viz.: the endowment of several professorial fellowships, each, say, of $1,000 annual in-

come; to be controlled and awarded by some independent scientific body (such as this Alliance might afford) for distinction in active scientific investigations, either within the country or within the State. I know of no more quickening impulse to original scientific research than such as would be given to it by those means.

How backward we have been in this country, through the lack of proper endowments, in making use of the best existing opportunities for research, may be illustrated by a single instance.

Some twenty years ago a school was established at Naples for the prosecution of marine biological research. It is most thoroughly equipped, and, being a general resort, is the most advantageous for study of any in the world. It is maintained by a charge of $500 per year upon each table occupied; each occupant being entitled to all the advantages of the institution. Of these tables, the German States for several years have taken thirteen; Italy, eight; Austria, Russia, Spain and England, each three; Switzerland, Belgium and Holland, each one; the United States, until 1891, none, except one table supported by Williams College for two years, and one by the University of Pennsylvania for one year. Prior to that time about fifteen other American students in all had obtained places at the tables taken and paid for by other nations. In 1890 this arrangement was prohibited by the administration of the institution; and the right to a table in 1891 was secured to Americans, only through the private benefaction of Maj. Alex. Henry Davis, of Syracuse. For the year 1892 the use of a table has been secured through a subscription started by the American Association for the advancement of science, towards which the Association itself granted out of its scanty funds one hundred dollars, and was the means, I believe, of procuring the rest.*

We have not, however, been wholly without some such means of study in this country, through the marine biological laboratories established some years ago at Newport and at Wood's Holl, by Prof. Alex. Agassiz. The former has been now enlarged so as to accommodate eight advanced students, besides

*See Proc. Am. Assn., 1891, Vol. 40, p. 449-451.

the Professor and his assistant.* The Johns Hopkins University, also, has supplied some opportunities of this kind by its summer school, formerly at Beaufort; later, at Jamaica; but at present, as I understand, it is without any permanent location.

Our neighbor, the Brooklyn Institute, has organized similar investigations, on a minor scale, during the summer months at different places on Long Island. But what is needed for the most effective work, is suitable endownents for professors and advanced students, in connection with an adequate Biological Laboratory, such as the Newport one enlarged might afford, equal in means and equipment to that at Naples, or at least to that recently completed, largely through private enterprise, at Plymouth, England.†

II.

Immediately connected with our colleges and universities is another field, in which additional endownments are greatly needed, viz: for fellowships in science for post-graduate studies.

Upon the post-graduate workers, the future of science, and the recruits for future teachers and professors, must necessarily depend. In that view the importance of post-graduate endowments in science can scarcely be magnified. The great majority of the young men from whom all the new recruits must be drawn, have little or no pecuniary means. After

*Report Harvard Col., 1891, p. 182.

†In his address before the American Association for the Advancement of Science, in 1891, President Prescott, referring to this general subject, said:

To * nurture * investigation in science is the largest opportunity before the American people. Research, systematic and wisely directed, requires good organization and strong support, the support of many powers. It must have the support of able and persistent men. It needs the conference of workers, and the dissemination of knowledge in societies like this. It wants the interest and the confidence of the public. It asks and will always obtain the constant, helpful use of the press. It requires distinct provision in colleges, and in the institutions of higher education. It ought to be sustained expressly by the Government, both in the several States and under the United States, and sustained on broad and permanent foundations. Still, it needs private benefactions. Research is the growth of years. Let it be the demand of all, and let this call find utterance everywhere. Proceedings 1891, Vol. 40, p. 440.

graduating, often through many difficulties, they must face the question of their future calling. They must consider what promise of a reasonable and comfortable support a life devoted to science affords. If this risk should not deter them, still there are many with talents of a high order who would be absolutely unable to proceed further in the advanced scientific studies necessary to qualify them to enter upon remunerative scientific work, or to obtain situations as professors or assistants, except by the aid of substantial endowments for their support, during the three or four years more of necessary assiduous study.

In the stress of modern life, and in the allurements towards more certain pecuniary results, nothing but such endowments can avert the withdrawal from scientific pursuits, of many young men of high promise, whose genius and tastes and ambition strongly incline them to science, and who would be secured to it if this temporary support were afforded.

The endowments of our colleges and universities in aid of post-graduate work in science are much less, I suppose, than is commonly imagined. I find no such support for post-graduate work in science, either at Cornell University, at the University of the City of New York, at Brown University, at Amherst, or even at the Johns Hopkins University. No statement of the endowments of the new Clark University at Worcester has as yet been published. Princeton, though having a hundred under-graduate scholarships, has but one post-graduate fellowship for science; Yale, but two—the Silliman and the Sloane Fellowships.

Columbia College has two fellowships expressly restricted to science, viz.: The Tyndall Fellowship of $648 annually, and the Barnard Fellowship, before referred to, of about $500 annually. Besides these, however, twenty-four general university fellowships have been established, of $500 each, for post-graduate study, of which eighteen are in present operation. About one-third of these are assigned to science; making now eight for science at Columbia, with probably two more in 1893 or 1894. In architecture, moreover, there are three additional noble post-graduate fellowships at Columbia, the Schermerhorn

of $1,300 annually, and the two McKim Fellowships of $1,000 each, to support study in foreign travel. In the Medical Department, also, there are five valuable prizes for proficiency.

The University of Pennsylvania has the Tyndall Fellowship, before referred to; and, in the Department of Hygiene, an admirable laboratory fitted up by Mr. Henry C. Lea, with a fellowship of $10,000 endowed by Mr. Thomas A. Scott, at present applied to original research in bacteriology.

At Harvard, besides the three Bullard Fellowships of $5,000 each, established in 1891, to promote original research in the medical school, there are two post-graduate fellowships restricted to science exclusively; namely, the Tyndall Fellowship of about $500 annually, and the income of the recently established Joseph Lovering Fund, the principal of which is now about $8,000. There are also eleven other general fellowships, viz.: The Parker, the Kirkland and the Morgan Fellowships, available for promising graduate students in any branch; of which about five have been usually assigned to science. These fellowships give an income of from $450 to $700 a year. Harvard has also forty-six scholarships available for graduate students, varying in income from $150 to $300 each, of which about seventeen are assigned to science. During the last year, according to the report of Prof. Pierce, the Dean, there were 193 applications for those post-graduate fellowships and scolarships, seventy-one of which were in science. Only one-third of the applicants could receive the aid. The Dean adds:

"The number of appointments is still *very insufficient* to meet the demands of promising students who wish to enter the graduate school and are unable to do so without assistance."* The tables published by him indicate that a considerable number of those not aided withdrew from science; and that many others who were entered for the first year in the graduate school, would, if not aided, afterwards leave. It is gratifying to observe the further fact, so encouraging also for the young graduates who wish, if possible, to enter upon a scientific career, that all who had enjoyed these fellowships for the full term of three years, and did not continue their studies further abroad, at once received honorable positions.

* Report Harvard Col. 1891, p. 92.

From the above synopsis it appears that in all these colleges (and I know of no other similar fellowships elsewhere) there are only about twenty-six adequately endowed post-graduate fellowships in science. As these should be continued for at least three years, there is provision altogether for only about nine per year—not one-fourth the number required to supply the annual loss in our 150 colleges, to say nothing of the increasing demand, through the growth and improvements in the colleges themselves. As it is from such specially trained students that the great professors of the future must be drawn, the need of much greater endowments for new recruits is apparent.

In England the aids afforded by fellowships in their universities are familiar to all. Sir Isaac Newton, who is to modern science what Shakespeare is in literature, was sustained from his student days successively in a scholarship, a fellowship, and as professor at Trinity College at Cambridge. Besides those aids, The Royal Commissioners of the Exhibition of 1851, instituted last year (1891) "Exhibition Science Scholarships" for advanced students, to which $25,000 yearly is to be applied in sums of $750 each. Last year sixteen appointments were made, to be held for two and probably for three years, by students who show capacity, and "who advance science by experimental work." *

On this subject a most interesting discussion took place last year in the French Academy of Science. On April 27, 1891, the Secretary read the following extract from the Will of the late M. Cahours, a deceased member of the Academy:

"I have frequently had the opportunity of observing, in the course of my scientific career, that many young men, distinguished and endowed with real talent for science, found themselves obliged to abandon it, because before beginning they had no efficacious help which provided them with the first necessities of life, and allowed them to devote themselves exclusively to scientific studies.

"With the object of encouraging such young workers, who,

* Per Sir William Thompson, Proceedings, Royal Society, 1891, Vol. 50, p. 225.

for want of sufficient resources find themselves powerless to finish works in course of execution, * * * I bequeath to the Academy of Science * * * 100,000 francs, * * * the interest to be distributed yearly by way of encouragement to any young men who have made themselves known by some interesting works, and more particularly by chemical researches; * * * as far as possible to young men without fortune, not having salaried offices, and who, from want of a sufficient situation, would find themselves without the possibility of following up their researches. These pecuniary encouragements ought to be given for several years to the same young men, if the Commissioner thinks their productions have sufficient value; * * * to cease when they shall have other sufficiently remunerative positions."

M. Janssen, then addressing the Academy, said:

"This affords an example to all who hereafter may desire to encourage the sciences by their liberality. M. Cahours, who knew the urgent necessities of science, had, like most of us, become convinced of the need of introducing a new form of scientific recompenses.

"Our prizes will always continue to meet a great and noble necessity. Their value, the difficulty of obtaining them, and the *eclat* they take from the illustriousness of the body that grants them, will always make them the highest and most valuable of recompenses.

"But the value, also, of the works it is necessary to produce in order to lay claim to them, forbids them to beginners. It is a field only accessible to matured talents.

"But there are many young men endowed with precious aptitudes, inclined to pure science, but turned very often from this envied career by the difficulties of existence, and taking with regret a direction towards more immediate results. And yet many among them possess talents, which, if well cultivated, might do honor and good to science. * * These difficulties are increased every day by the marked advance of the exigencies of life.

"We must find a prompt remedy for this state of things, if

we do not wish to see an end of the recruitment of science. This truth is beginning to be generally felt. The Government has already created institutions, scholarships and encouragements, which partly meet the necessity. Some generous donors are also working in this manner. I will mention specially the noble foundation of Mlle. Dosne, in accordance with whose instructions a hall is at this moment being built, where young men, having shown distinguished aptitudes for high administration, for the bar, or for history, will receive for three years all the means of carrying on high and peaceful studies. Let us say, then, plainly, and in speaking thus we only feebly echo the words of the most illustrious members of the Academy, that by following the way so nobly opened by Cahours, the interest and prospects of science will be most effectually saved.*

Huxley is said to have once stated that "any country would find it to its interest to spend $100,000 in first *finding* a Faraday, and then putting him in a position where he could do the greatest amount of work."

It is the *post-graduate endowments* that must find and retain to science the Faradays of the future.

A notable instance of the need and value of such aid is found in the recently appointed head of a great university, who by such endowments alone, here and abroad, it is said, was enabled to prosecute his studies for ten years successively, reaching thereby the front rank in his chosen Department of Philosophy.

III.

Another department in great need of pecuniary support is that of the learned and scientific societies. In these England is preëminent. Our own societies have endeavored to follow, so far as they could, their English models. The English societies have rendered to science invaluable service in three main lines:

1. In providing ample means for the publication of scientific papers, showing the progress and the results of their scientific work. In this every society has taken part.

*Nature, May 7, 1891.

2. In the direct maintenance of original research, in which the Royal Institution has been most conspicuous.

3. In the award of prizes for scientific distinction; but still more important, in the distribution of pecuniary aid, for the prosecution of special scientific researches.

(1). Of these, I regard publication as, perhaps, the most important; not only because it puts the world in possession of what has been done by investigators; but because the very fact that there are means of publication, is one of the greatest incitements to complete and thorough original scientific work.

Of the English societies, the *Royal Society* is the oldest, having been chartered in 1662. It has published 181 volumes of Transactions and about 50 volumes of Proceedings. For these purposes in 1881 the expenditure was between $11,000 and $12,000. It has property to the value of about thirds of a million of dollars, more than half of which is in trust funds, held for scientific uses. The income on the trust funds in 1891 was about $17,500.* In 1828 Dr. Wallaston in giving it $10,000 in 3 per cent consols "to promote scientific researches," charged upon the Society "not to hoard the income parsimoniously, but to expend it liberally for the objects named."

The *Royal Institution of Great Britain*, was founded in 1779, largely through our countryman, James Thompson, of Rumford, Vt., afterwards Count Rumford. In 1888 it had property and invested funds for general purposes to the amount of $350,000, and about $40,000 of invested funds for the maintenance of its three professors. In 1887 it expended about two thousand dollars in publications, and it has issued about forty volumes.†

The *Linnæan Society*, now furnished by the Government with permanent accomodations in Burlington House, free of rent, was founded by Sir James E. Smith in 1788, and is devoted to botany and zoölogy. Its property amounts to about $32,000, but it has no endowed funds for scientific investigation. For some some years past its receipts, mainly from contributions, have been about $10,000 a year, of which one-half, about $5,000, is

*Proceedings, 1891, Vol. 50, p. 235.

†Report 1888, p. 13.

spent on its publications, which now number nearly fifty volumes of transactions in quarto, and as many more of its Journal. In 1888 $7,000 dollars were expended in publication. *

Next in order of time is the *British Association for the Advancement of Science*, founded in 1831. It is sustained chiefly by yearly contributions. Its invested funds amount to about $62,000. Its income and contributions are about $10,000 annually, out of which it appropriates from $6,000 to $7,000 per annum for the encouragement of scientific investigations, and about $1,800 annually for its yearly volume of Proceedings. Its publications now number twenty-five volumes. †

The Ray Society was founded in 1844. It was named after the Rev. John Ray, who lived from 1628 until 1705. Haller, himself one of the greatest scientists of his time, writing in 1771, in the full light of Linnæus' fame, calls Ray "the greatest botanist within the memory of man." ‡ The society has published about fifty volumes of scientific works of the highest importance. I have not seen any statistics concerning its means or acquisitions; nor have I found any financial report of the scientific societies of Edinburgh or Dublin.

(2.) Of these societies, only the Royal Institution directly supports professors for scientific research. It has two laboratories, one chemical and one physical. These were rebuilt in 1872, "in order that original discovery might be more effectively carried on." The society was founded for the declared purpose of "promoting scientific and literary research." It has three professors—one in chemistry, one in physics and one in physiology. Davy, Faraday, Tyndall, and others who have spent their lives there, have made its annals immortal.

(3.) In stimulating research by the appropriation of moneys for specific objects, the Royal Society and the British Association are the chief agencies. Besides some of its own funds, the Royal Society distributes annually four thousand pounds, or $20,000, granted by the Government "for the advancement of science." This has been done by applying it to numerous

* Proceedings 1890, pp. 15, 45 [May 4, 1888.]

† Proceedings 1891, pp. LXXXVII to C. 76.

‡ Bibliotheca Botanica.

purposes; in 1891, for fifty-seven different scientific objects, in sums ranging from $25 to $3,000 each; not confined to natural science alone, but including ethnology and magnetic surveys. Most of the grants were in sums of about $350 or less.*

The British Association has disbursed annually, for the last forty years, from $6,000 to $7,000 per annum, upon the same system of dividing it up for numerous specific purposes; usually from thirty to forty objects yearly, the grants being in sums ranging from $25 to $1,000. The grants are called for and expended for the specific purpose named, and under the direction of some prominent scientific man. Scientists like Sir William Thompson, and others of like renown, have had the administration of many of these grants. These have included for the last six years, save in 1890, the appropriation of $500 per year for a table in the Naples Marine Laboratory.†

We have no single society In this country, save the Smithsonian, that can rival in importance those that I have named in England. And the Smithsonian is not a society, but an institution, established by one man, and he an Englishman. This institution, based upon the bequest of James Smithson, was founded by Act of Congress of August 10, 1846. I doubt whether in any country or in any age, the bequest of half a million of dollars has ever been followed by such beneficent results, or has ever so profoundly affected the life of science in any country as the Smithsonian Institution has done in America during the last forty-four years of its existence. This has been owing (1) to the wisdom and the profound scientific insight of Prof. Henry, its first secretary and director; and (2) to the corps of able assistants and successors whom his spirit and policy have inspired. Its publications number twenty-six quarto volumes of Contributions to Knowledge; forty volumes of Miscellaneous Collections; and forty-four volumes of Annual Reports. Its Contributions to Knowledge rival, if they do not excel, in rarity and importance, the publications of any other society during the same period. Its expenditure in publications is about $12,500 a year. Under Prof. Henry a good deal

*Proceedings, 1891, Vol. 50, p. 242.

†Proceedings, 1890, p. 90.

was done in research. Under Prof. Langley, the present director, astro-physical research is carried on. Besides the direct scientific work of the institution, however, its influence has been very great, especially in its relations with the other departments at Washington, and as a medium for the prosecution of other scientific enterprises, under authority of Congress. Many of the appropriations of Congress for scientific expeditions for researches in ethnology, paleontology, chemistry and physics, have been due to the presence and coöperation of the Smithsonian Institution. For ethnologic researches alone, during the last twelve years, under the administration of the Smithsonian, Congress has appropriated $400,000; to paleontologic researches within the last three years, $160,000; to chemical and physical research, $68,000; and to astro-physical research, $10,000. Besides these, there have been for many years appropriations for maintaining the important investigations of the Coast and Geodetic Survey, and of the Weather Bureau in Meteorology; and for the great scientific work of the Naval Observatory, and of the various scientific divisions of the Agricultural Department and of the Geological Survey. Our Government has been by no means inactive in science.

The principal American scientific associations, omitting those of comparatively recent origin, are the American Philosophical Society of Philadelphia, originally founded in 1744; The American Academy of Arts and Sciences at Boston; The Boston Society of Natural History; The Academy of Natural Sciences, and The Franklin Institute, at Philadelphia; the latter founded in 1824 (see Journal, vol. 1, pp. 71, 129); The New York Academy of Sciences (a continuation of the Lyceum of Natural History); The National Academy of Science at Washington, founded in 1863; and The American Association for the Advancement of Science. Of these, The Philosophical Society has published 29 volumes of its Transactions; The American Academy, 26 volumes of Transactions and 9 quarto volumes of Memoirs; The Boston Society of Natural History, 25 volumes, at a cost of about $600 per year; The Academy of Natural Science of Philadelphia, 48 volumes of Proceedings and 12 quarto volumes of its Journal, at an average cost

of about $1,000 per year; The Franklin Institute, 133 volumes of its Journal; The New York Academy and its predecessor, about 30 volumes of Transactions and Annals; The National Academy, 3 quarto volumes of Memoirs and some volumes of Proceedings; and The American Association for the Advancement of Science about 40 volumes of Proceedings.

The latter society had in 1891 a "Research Fund" of $5,254. (Proceedings 1891, p. 441). None of the other societies, so far as I can find, has any fund specially devoted to research, or makes any specific appropriations therefor. The National Academy and The Academy of Philadelphia have each some funds for their support, and the latter also the Jessup Fund for students in Science on which the income is about $550 yearly. The Philosophical Society from time to time awards the prize established by John Hyacinth de Magellan in 1786, an oval gold plate, "for the most useful discovery or invention in navigation or science." One of the earliest awards of this prize was for painting lightning rods with black lead.

The American Academy of Arts and Sciences awards a gold and silver medal from a bequest of $5,000, made to it by Count Rumford, who in 1796 made a similar bequest to the Royal Society. In 1888 this prize was most worthily awarded to Prof. Michelson, for his researches in light.*

The Boston Society of Natural History has a general fund, of which the income is about $6,000. It has also a small Walker Prize Fund and a Grand Prize Fund, from which in 1884 it awarded a grand prize of $1,000 to James Hall, of Albany, "for his distinguished services to science." It also administers the expenditure of about $2,700 a year for instruction in laboratory work, drawn from the Boston University, and $1,500 from the Lowell Fund for the instruction of teachers.†

From this comparison of the voluntary associations, it appears that the property, endowed funds, and equipment of the English societies named, are nearly ten-fold greater than the American, and their publications, double; while for direct original re-

*Pres. Lovering's Address, Proc., Vol. 24, p. 380.

†Proceedings, Vol. 24, p. 14.

search, our societies maintain *no* laboratories and no professors, as is done by the Royal Institution. The English societies distribute yearly from $25,000 to $30,000 for from sixty to seventy-five different scientific purposes; while ours make *no* such appropriations, simply because they have no funds. To supply this deficiency there is need of large endowments.

The publications of our societies are valuable; the papers have often been of a high character, rivaling those published abroad. But the funds available for publication are insufficient; it is always a question of means. There is a press and surplus of valuable scientific matter, which either is not printed at all, or only gets printed by special subscriptions for the purpose. This ought not to be. After valuable original matter has been produced with great pains and without hope of pecuniary reward, nothing is more discouraging to future research than that even publication can only be had as a charity. This I know, from repeated personal applications, is the condition of things in New York at this moment. It is not creditable that in a State and country like ours there should be practically nowhere any adequate provision for even the publication of the researches of those who work for nothing but their love of science and its progress. There is very great need of a considerable publication fund, in the hands of some scientific body, through which every valuable contribution to science, not otherwise provided for, might be ensured a speedy publication, after it has been found worthy, as in the practice of the Linnæan Society, first by a critical expert in the particular department, and then by the Council of Publication.*

The stimulus, moreover, to scientific research that would be imparted by the distribution of comparatively small sums, such as are given by the Royal Society and by the British Association, would also be very great; nor is there any reason why the founding of professorships for the express purpose of prosecuting original research in our scientific societies, after the model of the Royal Institution, should not in time be followed by results equally brilliant, and equally beneficial to mankind.

I have endeavored to point out three main directions in

*Pres. Carruthers, Proceedings, May, 1890, p. 39.

which there is urgent need in this country of pecuniary endowments.

(1). In the relief of professors during the transition of the colleges from the schoolmaster system to the university system, whereby all professors in science shall become actively enlisted in the prosecution of original discovery as a part of their duties.

(2). In providing for the future recruits in science, by more endowments for post-graduate study.

(3). By endowments of our scientific associations, both directly to promote original research, and especially also to supply larger means of publication.

It is gratifying to perceive what beginnings have been recently made in response to the needs of science. Only a short time since, in 1885, Mrs. Elizabeth Thompson of Stamford, Conn., gave $25,000 to a Board of Trustees of which Dr. Bowditch, of Boston, is president, for the "advancement of scientific research in its broadest sense." The income is annually distributed in sums of from two to five hundred dollars.

Mr. Hodgkins, of Setauket, Long Island, has recently bequeathed to the Smithsonian Institution $200,000, the income of one-half of which is to be devoted to research into the properties of atmospheric air.

Columbia College has, during the past year, received from Mr. De Costa's estate, before referred to, $100,000 for biology; Harvard, the Joseph Lovering Fund, above stated; $10,000 from Henry Draper for the photography of stellar spectra; the endowments in archæology, above named; and some smaller gifts for various scientific purposes. The University of Chicago and some other institutions have also received important gifts, not to mention those yet to be realized to other colleges from the estate of Mr. Fairweather.

By the recent bequest of Chas. Lennig, the Academy of Sciences, of Philadelphia, will, in time, receive $20,000; while half a million of dollars will go to the University of Pennsylvania in aid of instruction in theoretical and practical mechanics, and $200,000 to maintain scholarships. At this University, also, a superb structure for the "Wistar Institute of Anatomy"

is now building by Gen. Isaac J. Wistar, at a cost of about $200,000, including endowments designed for original research.*

Our reliance in this country must be mainly upon private endowments and an intelligent appreciation of the needs of science. The National Government has done, and is doing, much in certain directions. But aside from the dispositions of legislators, it is restricted by the provisions of the Federal Constitution, and by debated questions of constitutional right. State aid is not thus hampered; but State aid is difficult to obtain, to any adequate degree, on account of the previous habits, prejudices and political training of the people. No doubt this ought not so to be. The State of New York ought, abstractly considered, to maintain one university of the first class equal in every department to any in the world. But the multiplication of institutions already existing, local jealousies, and aversion to State taxation, make this now probably impracticable.

The remedy is with the people, and through their own voluntary methods. It is the people who have made our Government, its institutions, its methods, and the great aggregate, whatsoever it is, such as we see it to-day. Wealth is rapidly accumulating; much of it in the hands of those who, springing from the people, bear the love of the community in their hearts; and when they and the people at large shall come to see that the cause of scientific advance and the discovery of all new truth are in the deepest sense their cause, responses will, I believe, come to every urgent need; until the work of the people, by its own methods, shall, even in science, be able to confront, without shame, the best work of the monarchies of the Old World.

* Since the above was written an additional million of dollars has been given by Mr. John D. Rockefeller to the University of Chicago, making $3,600,000 given by him alone to that institution within less than three years, a munificence hitherto unexampled in private endowments, some portions of which, it is hoped, will be available for the maintenance of original scientific research.

ADDRESS OF PROF. H. CARRINGTON BOLTON,

ON

A PLEA FOR A LIBRARY OF SCIENCE IN NEW YORK CITY.

In science, as in other departments of modern thought and research, progress moves along two distinct lines apparently antagonistic, but, as may be easily shown, they are mutually helpful; these are a tendency to specialization and a growth in generalization. As each department of physical and natural science develops with prodigious rapidity, and becomes too comprehensive for the grasp of an individual mind, it becomes subdivided into branches dealing with a limited range of subjects, and, as these subdivisions continue to grow, further specialization necessarily ensues. This is a familiar truth, requiring no illustration beyond reference to the existence of seven independent societies in this Alliance, the younger members of which are limited to single branches of research. Parallel with this development of specialization, there is marked progress in the direction of coördination and inter-dependence. Even in the departments of investigation seemingly far removed from each other, how frequently discoveries and inventions unexpectedly open up common features. A chemist aided by a physicist, examining in a darkened room the flame-colors of terrestrial substances, suddenly hand over to the astronomer an instrument of precision surpassing the combined powers of the telescope and the microscope in revealing the secrets of celestial bodies. A solar-physicist, directing his sensitive bolometer to the radiant energy proceeding from a tiny insect, presents to the biologist new and remarkable facts otherwise unattainable. What two sciences seemed less likely to be linked for a man's benefit than acoustics and electricity? To what realm of nature is the microscope limited? To further multiply illustrations is needless; a moment's reflection shows theoretical points of contact between every one of the exact sciences which are

realized in practical applications resulting from their coördination.

This linking of specialization and generalization finds its highest exemplification in a library, particularly in one consecrated to pure and applied science. One of the objects sought by the promotors of this Alliance of the principal scientific societies of New York City is the assembling under one roof of their scattered collections of books. This does not mean amalgamation in any degree, nor even confederation; this is practically impossible, for several of the societies are incorporated and cannot surrender rights in their property. The plan, as I understand it, leaves to each society complete control of its own library, and merely provides for coöperation, each supplementing that which is lacking in the others. Before considering the advantages which would certainly follow such affiliation, let us briefly note the statistics of each society, considering them in order of their foundation.

(1). *The New York Academy of Sciences*, founded in 1817, has a library of nearly ten thousand volumes and bound pamphlets, temporarily deposited in the library-building of Columbia College, by courtesy of the Trustees. It is not amalgamated with the great library of the College, having separate rooms and an independent Catalogue. The Collection is almost exclusively scientific, and is valuable for its sets of Transactions of learned societies throughout the world, obtained by exchange for the publications of the Academy. Many of these early serials are not found elsewhere in the city, and some nowhere in the United States.

The library is, of course, free to members under the by-laws, and to readers in the College library by special arrangement. The library is in very good condition, which, however, would be improved by expending a few hundred dollars in binding. The Academy was so unfortunate as to lose its collections in natural history by fire in 1866, but the library was stored elsewhere, and has now reached the respectable age of 75 years, being the fifth in order of foundation in New York City.

(2). *The Torrey Botanical Club*, founded in 1871, has no independent library, its collection being incorporated with the

library of Columbia College. The University Bulletin for July, 1892, records the securing of a fund of $1,000 for the purchase of books for the Botanical Library, a fund contributed by ten persons. While this is creditable it shows how pressing the need is for botanical literature, and the Club might perhaps be persuaded to administer a much larger sum.

(3). *The New York Microscopical Society*, founded in 1877, is incorporated under the State laws. It has a library of about 1,500 volumes, but it is at present difficult of access to members owing to cramped and inconvenient quarters; hence it is but little used.

(4). *The Linnæan Society of New York*, organized in 1878, not incorporated, has the nucleus of a library deposited in the American Museum of Natural History, Central Purk.

The collection consists chiefly of serials obtained by exchange, and of government publications.

(5). *The New York Mineralogical Club*, organized in 1877, not incorporated, has no library. It owns, however, the B. B. Chamberlain Collection of N. Y. Island Minerals, and other local specimens deposited in the American Museum of Natural History.

(6). *The New York Mathematical Society*, organized in 1888, not incorporated, owns a collection of about 300 volumes, now temporarily deposited in the Mathematical Department of Columbia College.

(7). *The New York Section of the American Chemical Society* is the youngest child in this family, having been organized in the spring of 1892. The parent society, however, was founded in 1878, and has accumulated a library of 1,900 volumes and 500 pamphlets, now deposited in the building of the University of the City of New York. It is, of course, open to members and those using the University library.

These collections, brought together under one roof, would form the nucleus of a valuable scientific library. The weakness of some is due to youth; all, however, reflect the struggle for existence that pure science has sustained in this commercial city. The advantages that would flow from affiliation are so obvious as to make rehearsal almost superfluous. First, how-

ever, is the advantage of economy in administration, and, by avoiding duplication, securing greater results with less expenditure. Secondly, uniformity in disposition of the books, and improvements in cataloguing. And be it noted, that the utility of a library is in proportion to the perfection of its catalogue; other things being equal, a small collection being furnished with full author and subject-catalogues is decidedly more valuable than a library of far greater magnitude which is incompletely catalogued. Such an assemblage of books, with the growth that would be stimulated by the new régime, would form the foundation of a great BIBLIOTHECA SCIENTIÆ, such as nowhere exists in our New World. Due appreciation of the creditable standing of several libraries in New York and vicinity is consistent with the statement that a scientific library is a great want. For general reference the Astor will long remain preëminent; Columbia College Library is growing rapidly, and its liberal regulations and fine appointments are a delight to scholars; the Lenox has a noble collection of treasures limited to a narrow field; the physicians, lawyers and engineers are forming for themselves specialized collections of great value; the Free Circulating Library and many subscription libraries cater to the popular taste; but where shall investigators in the exact sciences go with an assurance of finding all desirable treatises, serials and special monographs?

Another advantage of affiliation must be briefly noted. One of the best ways of building up a library symmetrically is to place the selection of books in the hands of workers in the several branches of knowledge; this is recognized in some colleges, where each member of the Faculty compiles lists of works needed in his special field. In the associated libraries, each Society would naturally foster its immediate interests, and lacunæ could be filled by the care of the librarian-in-chief.

It is, perhaps, premature to consider the question of organization of the Library of the Scientific Alliance, but I would suggest that at first the librarians of the several societies might form a board, and by frequent consultations secure uniformity in methods. Later in the development of the library a librarian-in-chief might be appointed to have general oversight of

the whole, especially to see that gaps in the literature of science, not filled by the societies themselves, be closed by purchase. For, of course, the Library of the Scientific Alliance must have an endowment, and one worthy of this great metropolis.

The benefits that a Library of Pure and Applied Science would confer on the City are manifold. It would become the headquarters of those engaged in pure research, as well as of inventors and others seeking data as to the applications of science. To patent-lawyers such a library would be invaluable. If the Alliance be successful in securing a convenient site and a building of sufficient magnitude, I suggest further that rooms of moderate dimensions be provided for rental to private collectors of books for their personal treasures. Many persons of moderate means find the question of shelf-room a more troublesome one than the acquisition of books, and buy more sparingly for this very reason; they would be glad, however, to place their collections in a fire-proof building, contiguous to kindred or supplemental collections, and, maintaining their control of their private libraries, would willingly grant to scholars access to the same for consultion and serious research. Such temporary deposits might eventually become the property of the Alliance, either by gift or testamentary bequest.

The Alliance is moreover likely to add to its membership other societies pursuing special branches of science, and this growth must be anticipated in planning for the future.

The associated libraries of the Scientific Alliance, gathered in a suitable building furnished with committee rooms, lecture-hall, etc., would form for those engaged in scientific research a sort of Exchange. Commercial and financial enterprises have established produce exchanges, metal exchanges, stock exchanges and the like, and why should not Science have its own exchange? Though the commercial aspect is far removed from the thoughts of those advocating this Alliance, I see no reason why the building sheltering the libraries should not be headquarters for those seeking advice from scientific men on industrial problems.

Comparisons are said to be odious; therefore I refrain from pointing out how much behindhand New York City is com-

pared with Boston, Philadelphia and San Francisco in the matter of accommodations for scientists.

To ascertain the status of science in the existing libraries of New York and vicinity, I sent to 68 of the principal libraries and institutions of learning circulars making inquiry as to the number of volumes in each, the proportion of scientific works, and the number of scientific readers using the library. With few exceptions replies were received with gratifying promptness and accuracy. Eight libraries have not been heard from. The statistics obtained are embodied in the Appendix to this paper, and we give here but a brief summary.

The sixty libraries reporting have an aggregate of 1,916,000 volumes. There are fifteen libraries of over 40,000 volumes each. The proportion of scientific books varies from 5 per cent. to 100 per cent., according to the scope and aim of the institution. In the larger libraries of reference the proportion runs from one-quarter to one-twentieth. As the term science is differently interpreted by librarians, some restricting it to pure science, and others embracing the applications, biography of scientific men, and the useful arts, no attempt has been made to estimate the total number of volumes that are properly classed as scientific. As but few libraries report the number of scientific readers, this item remains practically undetermined.

In one class of institutions a great weakness was developed by this inquiry; with a single exception medical colleges report "no library;" surely in no other course of study is a knowledge of literature of the subject deemed superfluous. The exception referred to is the Woman's Medical College of the New York Infirmary, which has a collection of 556 volumes, forming a small reference library for the students. This was founded in 1887 by the liberality of Sarah M. Hitchcock, and is growing annually by subscriptions and donations.

In conclusion, allow me to relate a legend:—Long ago, before the age of printing, an Oriental monarch succeeded to to the throne, whose first care, strange as it may seem, was the welfare of his subjects. Feeling the responsibility of his sceptre, and desirous of gaining knowledge that would enable him

to rule justly, he planned to make a collection of the works of most eminent authors, that by their perusal he might learn to govern his people with true wisdom. With this end in view he commanded that rolls and parchments from all provinces of his realm be sent to the royal capital, in which he caused to be constructed a noble treasure-house for their reception and preservation.

After some years of labor, those in charge of this undertaking announced the completion of the Bibliotheca and invited their royal master to inspect it. As he walked through the splendid building and gazed upon the multitude of books crowding the alcoves, he perceived with regret the physical impossibility of examining in person these treasures of learning to acquire that knowledge for which he longed. Impressed with his weakness he appointed a Commission of four and twenty wise-men, whose duty it should be to read and digest this collection of books, and to condense all the good and useful of their contents into a few volumes.

Ten long years elapsed, when the Commission of wise-men submitted the results of their arduous labors in the shape of a camel-load of manuscripts. Meanwhile the good prince had begun to feel the advance of time in his failing strength and weakened eyesight, so that the perusal of a camel-load of books now seemed to him more onerous than the task from which he had shrunk ten years before. Accordingly he thanked the Commissioners for their labors, and dismissed them with royal gifts; and at the same time he commanded seven of the chiefest wise-men in the kingdom to further condense the contents of the camel-load of books into the compass of a single volume.

Five years rolled by; the aged monarch meanwhile had been laid on a bed of suffering by a mortal disease, and when the chief of the Seven laid in his palsied hands the thin manuscript containing the sum of human knowledge, the royal eyes were too dim, and the brain too weak, to attempt its study. But, stimulated by an intense desire to learn the truth, the weakened prince suddenly revived his fast failing energy, and, addressing the chief of the wise-men, said: "I command

thee instantly, under penalty of death, to express in one sentence the sum of human knowledge as found in this book."

Leaning over the bedside of the expiring prince, the faithful subject whispered into the still sensitive ear these words: "Man is born, he suffers, and dies."

As you all perceive, this legend is only partially applicable to my theme; in the present stage of intellectual advancement, we cannot hope to compress an epitome of human knowledge into a single volume; nor is the scheme altogether desirable, for we admit the advantages of specialization.

But can we not imitate the Oriental monarch to the extent of gathering under one roof the scattered libraries of the Societies composing the Scientific Alliance, and by unity in diversity faciliate the work of those who, like the good prince in the fable, devote themselves unselfishly to the discovery of the truths of Nature and the revelations of Nature's God.

APPENDIX TO PROFESSOR BOLTON'S ADDRESS.

Statistics of Libraries in New York City and Vicinity, with Special Reference to Science.

In the following pages the numbers in parentheses have the significance here indicated:

(1) Date of foundation, organization or incorporation.
(2) Location of the library.
(3) Approximate number of volumes.
(4) Proportion of scientific books.
(5) Proportion of scientific readers.
(6) Remarks.

The libraries are arranged in order of foundation under the respective cities: New York, Brooklyn, Hoboken, Jersey City. Clubs are not included, being essentially private libraries. Additional details of the special collections in several of the libraries will be found in Bibliographical Contributions of Harvard College, No. 45. Notes on Special Collections in American Libraries, by William Coolidge Lane and Charles Knowles Bolton, Cambridge, Mass. 1892.

Thanks are due to the Librarians named below for attention to correspondence.

NEW YORK SOCIETY LIBRARY.

Librarian: W. S. Butler.

(1) 1700 (as the City Library); 1754 (as the Society Library). (2) No. 67 University Place. (3) About 90,000 volumes. (4) About one-seventh. (5) About one-twelfth.

COLUMBIA COLLEGE LIBRARY.

Librarian: George H. Baker.

(1) 1754. (2) 150,000 volumes. (4) About 25,000, say one-sixth. (5) No data.

(6) Is rapidly growing; is open for readers from 9 a. m. to 11 p. m., daily.

LIBRARY OF THE NEW YORK HOSPITAL

Librarian: Frank P. Foster.

(1) 1796. (2) No. 6 West 16th street. (3) 20,000 volumes (4) Nearly all medical. (5) No data.

NEW YORK HISTORICAL SOCIETY.

Librarian: Charles Isham.

(1) 1802. (2) 170 Second Avenue. (3) 85,000 volumes. (4) Comparitively few scientific books. (5) None.

(6) The collection relates to American History only.

NEW YORK ACADEMY OF SCIENCES.

Librarian: James F. Kemp.

(7) Founded 1817. Incorporated. (2) Deposited temporarily in Columbia College library-building. (3) About 10,000 volumes and bound pamphlets. (4) Almost exclusively scientific, say 95 per cent. (5) Undetermined; is open to all readers in the College Library.

(6) Valuable for its sets of Transactions of Learned Societies throughout the world, obtained by exchange.

FREE LIBRARY OF THE GENERAL SOCIETY OF MECHANICS AND TRADESMEN OF THE CITY OF NEW YORK.

Librarian: Jacob Schwartz.

(1) 1820. (2) No. 18 East 16th street. (3) 95,000 volumes. (4) About 6,000 volumes, say one-sixteenth. (5) No data.

MERCANTILE LIBRARY.

Librarian: W. T. Peoples.

(1) 1820. (2) Astor Place. (3) 240,561 volumes (July 1, 1892). (4) About ten per cent. (5) Circulation of scientific books about five per cent. of the whole.

(6) A subscription library, founded for the benefit of merchants' clerks.

LIBRARY OF THE NEW YORK LAW INSTITUTE.

Librarian: William H. Winters.

(1) 1828. (Incorporated 1830). (2) Post Office building. (3) 39,500 volumes. (4) Exclusively law and works of reference.

AMERICAN INSTITUTE.

Librarian: JOHN W. CHAMBERS.

(1) 1833. (2) No. 111–115 West 38th street. (3) 13, 581 volumes. (4) Over two-thirds scientific. (5) Members of the Institute. Strangers welcome to consult the library.

(6) The library was first formed as a Statistical Library; it contains complete sets of the most important scientific works in English. For the past ten years the purchased books are exclusively scientific.

THE ASTOR LIBRARY.

Superintendent: ROBBINS LITTLE.

Librarian: FREDERICK SAUNDERS.

(1) Incorporated 1849. (2) No. 40 Lafayette Place. (3) 240,000 volumes and 100,000 pamphlets. (4) One third to one quarter. (5) About 50,000 readers per annum.

(6) The library is rich in transactions, serials, and has full sets of patents.

AMERICAN GEOGRAPHICAL SOCIETY.

Librarian: GEO. C. HURLBUT.

(1) Founded 1852. (2) No. 41 West 29th street. (3) 24,000. (4) 1 in 7. (5) No data.

(6) The real growth of the library dates from 1870.

COLLEGE OF THE CITY OF NEW YORK.

Deputy Librarian: H. E. BLISS.

(1) Organized 1852. (2) Corner Lexington Avenue and 23d street. (3) About 26, 800 volumes. (4) About 5,000 volumes, say one-fifth. (5) Used by 47 instructors and 1,200 students.

(6) New arrangement in progress.

YOUNG MEN'S CHRISTIAN ASSOCIATION.

TWENTY-THIRD STREET BRANCH. *Librarian:* R. B. POOLE.

(1) 1852. (2) No. 52 East 23d street. (3) 40,000 volumes. (4) About one-twentieth. (5) About one-twentieth.

COOPER UNION FOR THE ADVANCEMENT OF SCIENCE AND ART.

Curator of Library: J. C. ZACHOS.

(1) Incorporated 1857. (2) Fourth Avenue and Eighth street. (3) 31,873 volumes. (4) About 3,000, say one-tenth. (5) This free

library has a daily average attendance of 1,500 readers. The complete set of the Reports of the Patent Office was examined by 919 readers in 1891.

(6) The reading room was visited by over 400,000 persons in the year 1891.

AMERICAN NUMISMATIC AND ARCHÆOLOGICAL SOCIETY.

Librarian: Bauman L. Belden.

(1) 1858. (2) Academy of Medicine Building, No. 17 W. 43d St. (3) About 1,200 bound volumes and 4,000 pamphlets and unbound volumes. (4) About five-sixths. (5) Used by the members of the Society, 140. (6) Probably the largest numismatic library in the country.

MAIMONIDES LIBRARY.

Librarian: Max Cohen.

(1) 1858. (2) No. 203 East 57th street. (3) 40,000 volumes. (4) About 2,600 scientific books. (5) The circulation of science is about 5 per cent of the total.

MOTT MEMORIAL LIBRARY and LIBRARY OF THE NEW YORK STATE MEDICAL ASSOCIATION.

Director: J. W. S. Gouley.

(1) 1867. (2) No. 64 Madison Avenue. (3) about 13,000 volumes and 5,000 pamphlets. (4) Almost wholly medical and scientific. (5) 764 readers in 1891, chiefly physicians.

(6) The Mott Memorial Library and the Library of the New York State Medical Association are under one roof and free to all for reference.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

Librarian: F. Collingwood.

(1) 1868. (2) 127 East 23d street. (3) 15,000 volumes, including pamphlets. (4) Seven-eighths. (5) Almost wholly.

(6) The library was founded through a donation of the late Wm. G. Arthur; it is practically free, being open to all interested in engineering.

COLLEGE OF PHARMACY OF THE CITY OF NEW YORK.

Chairman Library Committee: Charles Rice.

(1) No definite date; the library has grown systematically since

1868. (2) Nos. 209–211 East 23d street. (3) About 4,000 volumes and 600 pamphlets. (4) Almost exclusively scientific. (5) Besides members of the College, about 400 persons per annum.

(6) The library is rich in pharmacy, botany, chemistry and materia medica, containing some works not found elsewhere in New York.

WASHINGTON HEIGHTS FREE LIBRARY.

Librarian: EDWARD GRIFFIN.

(1) 1868. (2) Corner of 156th street and Amsterdam Avenue. (3) 8,328 volumes. (4) 200 volumes or more. (5) 500 readers per annum.

LENOX LIBRARY.

Assistant Librarian: WILBERFORCE EAMES.

(1) 1870. (2) Fifth Avenue, between 70th and 71st streets. (3) About 70,000. (4) See (6). (5) No data.

(6) The Lenox library consists of several special collections on literary and antiquarian subjects. The R. L. Stuart Collection of angling literature includes some works of ichthyology; the Drexel Musical Collection contains works on acoustics. Besides these there are no books on natural science.

NEW YORK GENEALOGICAL AND BIOGRAPHICAL SOCIETY.

Librarian: G. H. VANWAGENEN.

(1) 1870. (2) 23 West 44th street. (3) 2,500 volumes. (4) Wholly genealogical and biographical. (5) No data.

YOUNG WOMAN'S CHRISTIAN ASSOCIATION.

Librarian: SARAH W. CATTELL.

(1) 1870. (2) East 15th street. (3) 19,000 volumes. (4) About 400 volumes. (5) Very few. In 1891, of a circulation of 44,577 volumes, only 432 were on science.

LIBRARY OF THE ASSOCIATION OF THE BAR OF THE CITY OF NEW YORK.

Librarian: WILLIAM J. C. BERRY.

(1) 1870. (2) West 29th street. (3) 40,000 volumes. (4) Exclusively law books and works of reference.

THE TORREY BOTANICAL CLUB.

Librarian: Effie A. Southworth.

(1) Founded in 1871. (2) Incorporated with the Botanical Library of Columbia College.

NEW YORK ACADEMY OF MEDICINE.

Librarian: John S. Brownne.

(1) 1874. (The Academy was instituted in 1847). (2) 17–21 West 43d street. (3) About 45,000 volumes. (4) About 1,000 not strictly medical. (5) About 7,000 readers yearly.

(6) The library ranks third in size of the medical libraries of the United States.

UNIVERSITY OF THE CITY OF NEW YORK.

Librarian: L. J. Thompkins.

(1) About 1875. (2) Washington Square. (3) About 18,000 volumes. (4) About 3,000 volumes science, say one-sixth. (5) Scientific students.

(6) Reading room is open from 9 a. m. to 9:30 p. m., and is free to all who will comply with our rules.

EQUITABLE LAW LIBRARY.

Librarian: Thomas Campbell.

(1) Founded 1876. (2) No. 120 Broadway. (3) 13,500 volumes. (4) Wholly on law.

NEW YORK MICROSCOPICAL SOCIETY.

Librarian: Ludwig Riederer.

(1) Founded 1877. Incorporated. (2) No. 64 Madison Avenue. (3) About 1,500. (4) Wholly scientific. (5) Undetermined.

(6) Difficult of access owing to small quarters, and hence little used.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

Librarian: C. E. Munsell.

(1) Organized 1892. Parent Society founded 1878 and incorporated. (2) Deposited in the Library of the University of the City of New York. (3) 1,900 volumes and 500 pamphlets. (4) About 95 per cent. scientific. (5) About 50 readers per annum. Open to those using the University Library.

THE LINNÆAN SOCIETY OF NEW YORK.

Librarian: ARTHUR H. HOWELL.

(1) Organized 1878. Not incorporated. (2) American Museum of Natural History, Central Park. (3) Not reported. (6) Consists of exchanges and Government publications.

AMERICAN MUSEUM OF NATURAL HISTORY.

Librarian: ANTHONY WOODWARD.

(1) About 1880. (2) Manhattan Square, Eighth Avenue and 77th street. (3) About 25,000 volumes and 10,000 pamphlets. (4) 95 per cent. (5) No data.

(6) The library embraces the following special collections (donated or purchased): The Jay Collection on Conchology; The Brevoort Collection on Ichthyology; D. G. Elliot Collection on Ornithology; S. L. Elliot Collection on General Science; The Edwards Collection on Entomology; The Whitfield Collection on Palæontology; The Cotheal Collection on Botany and Microscopy.

NEW YORK FREE CIRCULATING LIBRARY.

Librarian: ELLEN M. COE.

(1) 1880. (2) No. 49 Bond street, with three branches. (3) Nearly 60,000 volumes. (4) About 8,000 volumes, say seven per cent. (5) About seven per cent.

(6) The scientific books are chiefly popular and elementary; the reading of science is greatly increasing.

AGUILAR FREE LIBRARY.

Librarian: PAULINE LEIPZIGER.

(1) Incorporated 1886. (2) 197 East Broadway, and two branches 721 Lexington Avenue and 624 East 5th st. (3) 18,000. (4) 497. (5) Five per cent.

YOUNG MEN'S CHRISTIAN ASSOCIATION, RAILROAD BRANCH.

Librarian: W. F. STEVENS.

(1) 1887. (2) 361 Madison Avenue. (3) About 600. (4) About four per cent. (5) About 150.

(6) Rich in Railroad literature, which is not included in the answer to (4).

THE NEW YORK MATHEMATICAL SOCIETY.

Librarian: D. A. MURRAY.

(1) Organized 1888. Not incorporated. (2) Mathematical Department of Columbia College. (3) About 300 volumes. (4) All scientific, say 100 per cent. (5) and (6) No data.

WOMAN'S MEDICAL COLLEGE OF THE NEW YORK INFIRMARY.

Librarian: ELLEN K. LEUTE.

(1) 1887. (2) 321 East 15th street. (3) 556 volumes. (4) All medical.

(6) Founded by Sarah M. Hitchcock.

THE BENJAMIN AND TOWNSEND LIBRARY.

Librarian: F. E. FALKENBERG.

(1) 1888. (2) On Bellevue Hospital Grounds, First Avenne between 16th and 27th streets. (3) 2,000 volumes. (4) 20 volumes. (5) 2.

COLLEGE SETTLEMENT LIBRARY.

Librarian: AMY P. HALL.

(1) 1889. (2) No. 95 Rivington street. (3) 2,000 volumes. (6) The Library is used mostly by children in uneducated families, and the books mostly read are histories, biographies and fiction. The proportion of scientific works is small and they are chiefly elementary.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Librarian: E. C. GRIFFIN.

(1) 1890. (2) 12 West 31st street. (3) 4,000 volumes. (4) All scientific. (5) Wholly scientific.

(6) The library is free to the public, but no books can be removed from the building.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Secretary: RALPH W. POPE.

(1) 1890. (2) No. 12 West 31st street. (3) The library occupies space jointly with that of the American Society of Mechanical Engineers.

Brooklyn Libraries.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

Librarian: Franklin W. Hooper.

(1) 1823. (2) Fulton and Bond streets. (3) 13,500 volumes. (4) 4,200, say one-third. (5) 1,200 readers.

(6) Special collections of value: 600 works on entomology; 1,100 geographical publications.

THE LAW LIBRARY IN BROOKLYN, and THE LAW LIBRARY OF THE SECOND JUDICIAL DISTRICT.

Librarian: S. C. Betts.

(1) 1850. (2) County Court House. (3) Over 14,000 volumes. (4) Wholly on law.

YOUNG MEN'S CHRISTIAN ASSOCIATION.

Librarian: S. H. Berry.

(1) 1854. (2) 502 Fulton street. (3) 12,000 volumes. (4) 580 volumes.

BROOKLYN LIBRARY.

Librarian: W. A. Bardwell.

(1) 1857. (2) 197 Montague street, Brooklyn Heights. (3) 115,000 volumes. (4) About 17,000 volumes, say one-seventh. (5) No data.

LONG ISLAND HISTORICAL SOCIETY.

Librarian: Emma Toedteberg.

(1) 1863. (2) Corner Pierrepont and Clinton streets, Brooklyn. (3) 47,000. (4) Very small. (5) Almost none.

(6) The library is especially devoted to local history and genealogy.

ADELPHI ACADEMY.

Librarian: Mabel A. Farr.

(1) 1869. (2) Clifton Place, Brooklyn. (3) 3,000 volumes. (4) About one-twentieth. (5) About 20.

(6) Confined to Instructors and pupils of the Academy, 170 in number.

MEDICAL SOCIETY OF KING'S COUNTY.

Librarian: William Browning.

(1) 1874. (2) 356 Bridge street, Brooklyn. (3) 5,500 volumes. (4) Wholly on medicine and allied sciences. (5) Members of the Society, 500.

(6) Public and free for consultation. A new building is in progress. The Hoagland Laboratory library complements medically the above and is free to members by card.

FREE LENDING LIBRARY OF THE UNION FOR CHRISTIAN WORK.

Librarian: Fanny Hull.

(1) 1882. (2) 67–69 Schermerhorn street. (3) 22,000 volumes. (4) 2,306 volumes. (5) 150 scientific readers.

PRATT INSTITUTE.

Librarian: M. W. Plummer.

(1) 1888. (2) 215 Ryerson street, Brooklyn. (3) 35,000 volumes. (4) About one-seventeenth (not including useful arts and biography). (5) No data.

THE HOAGLAND LABORATORY.

Librarian: George T. Kemp.

(1) 1888. (2) Corner Pacific and Henry streets. (3) 1544. (4) 100 per cent.

(5 and 6) The library is rich in foreign serials on bacteriology, pathology, histology, physiology and experimental therapeutics.

Hoboken Libraries.

STEVENS INSTITUTE TECHNOLOGY.

Librarian: A. Riesenberger.

(1) 1871. (2) Corner Hudson and 5th streets, Hoboken. (3) About 7,500 volumes. (4) Exclusively scientific. (5) Consulted by alumni and undergraduates, say 600 persons.

FREE PUBLIC LIBRARY, HOBOKEN, N. J.

Librarian: Thomas F. Hatfield.

(1) 1890. (2) Second National Bank Building. (3) 7,343 volumes. (4) 540 volumes, say one-thirteenth. (5) No data.

Jersey City Libraries.

FREE PUBLIC LIBRARY, JERSEY CITY, N. J.

Librarian: GEORGE WATSON COLE.

(1) 1889. (2) Corner Washington and York streets. (3) 25,312 volumes (July 1, 1892). (4) 1,405, say one-eighteenth. (5) Out of a circulation of 294,796 volumes, 7,417 were scientific.

(6) Books on electricity and engineering are more largely called for than other branches of science.

NOTE.—The following institutions of learning report no libraries:

Bellevue Medical College.
Medical Department of the University of the City of New York.
College of Physicians and Surgeons.
Long Island College Hospital.

From eight additional libraries not herein named, no replies were received to duplicate circulars of inquiry. From one library the circular letter was returned through the post office marked "removed, present address unknown."

UNIVERSITY CLUB, September, 1892.

ADDRESS BY PROFESSOR N. L. BRITTON,

ON THE

KIND OF BUILDING REQUIRED BY THE SCIENTIFIC ALLIANCE.

The idea of a suitable building to house the scientific associations of this city is not new. It has been discussed in one form or another for many years, and was a favorite plan of Dr. Newberry during his long and invaluable services as President of the New York Academy of Sciences. Once or twice he appeared to be on the verge of accomplishing the object, and the failure of the attempts was a great disappointment to him. The need of such a structure really began at the time of the loss, through financial complications in 1844, of the old Lyceum of Natural History Building, which stood on Broadway near Prince street, and the subsequent distruction of the Lyceum's collections by fire. This most calamitous conflagration, besides destroying a very large amount of valuable scientific material, some of which can never be replaced, and rendering the Academy of Sciences—then the only scientific organization in the city—homeless, gave a blow to the progress of Science here from which recovery has never quite been made, and was the cause of the loss of local interest in scientific subjects, while their study was being vigorously prosecuted in the neighboring cities of Philadelphia and Boston.

The establishment of the School of Mines of Columbia College, in 1864, and of the grand Institution of which we are tonight the welcome guests, in 1869, and the phenomenally rapid and successful developement of both, have given during recent years an impetus to Science which bids fair to place New York in its proper position as not only the commercial, literary and artistic, but also the scientific centre of North America. The possibilities for research and instruction opened up by the recent establishment of the new Aquarium at Castle Garden, the organization of the new Faculty of Pure Science in Col-

umbia College, and the bright prospect for the early foundation of a well-equipped Botanic Garden in Bronx Park, are indications, among others, which point to our rapidly approaching scientific preëminence.

During this period the scientific societies have been slowly but surely increasing in strength and influence. While apparently a slight feature in the intellect of the city, they are really the principal bonds of union between those who pursue the lines of scientific thought, and the factors which give the greatest encouragement for scientific work, by virtue of the opportunities they afford for the presentation and publication of the results of research and discovery; for the true man of Science differs from other men in this, that if he discovers any facts which appear to add anything to the sum-total of human knowledge, or believes that he can explain already known facts in a more philosophical manner than they have hitherto been explained, his first impulse is to give his results and ideas to the world for what they may be worth towards the solution of the problems of Nature, instead of secreting them in the hope that they may be of some particular value to himself. For this, if for nothing else, these organizations deserve all the encouragement that can be extended to them. Think for a moment of a city of the present day without scientific associations. It would be regarded the world over as a desert place in the realm of intellect.

The character of the building which is needed for the successful prosecution of the work the societies forming the Scientific Alliance of New York desire to accomplish may be outlined in a few sentences;

1. Provisions for the shelving and ready consultation of their libraries which now, collectively, comprise about 20,000 books and pamphlets, and are being augmented more rapidly than ever before by the steady stream of publications issued by similar organizations all over the world received in exchange for the serials and journals published here. A single large room, built with alcoves, in order to afford a method of keeping the several libraries distinct, would, we conceive, be the most satisfactory arrangement, or it might be

deemed more convenient and economical to keep the books in a single series and those of each society designated by distinctive book-plates, gilding and cataloging. We believe that in determining the size of this room, provision should be made for the shelving of not less than 300,000 volumes, for in addition to the accumulations alluded to, it is certain that contributions would continually be made to this library by some of the members.

2. A lecture-room constructed to seat not less than 1,000 persons, in which a constant series of lecture-courses on scientific topics should be offered to the people of New York, free of all charges.

3. A small room as an office for each society, place for committee and special meetings at which the attendance would not be large, space for the deposition of their archives and other papers of value. So far as we can now foresee, about ten such rooms would be required, there being seven organizations now in the Alliance and others that may be admitted. The probability of new scientific associations being founded is not great. Provision for such already exists in the permission for the establishment of Sections in the Academy of Sciences.

4. A number of rooms constructed to seat about 100 persons each, for the ordinary meetings of the societies. Economy of space could here probably be effected by the common use of the same room by two or more societies, as not more than two of them would be likely to desire to meet at the same time, a large number of persons being members of two or three of the organizations.

5. Small rooms fitted up for Photographic and Microscopic Laboratories, and for the storage of apparatus and other material.

6. A general meeting-room for members of the societies and their friends, which should be open at all times as a kind of social, scientific centre, similar to the Cosmos Club at Washington which has been such a great success.

The realization of such a scheme calls for a fire-proof building about 100 by 120 feet square, four stories high on the

front, with the large lecture-room behind, the Library and Club-room on the ground-floor front and the meeting-rooms, offices etc., above. It should be located in a central part of the city, and its maintenance should be provided for without expense to the societies, which need all the income they have or can obtain for research and publication.

It is needless for me to state that a very large sum of money would be required for such a structure. But we hope, and not without considerable encouragement, that in one way or another the means will be forthcoming. Such a building, or a slight modification of it, could be used to advantage by other organizations whose work was not incongruous with the objects that the Scientific Alliance wishes to attain, and it may be that we shall receive support from such. The societies devoted to Art, Music and Charity are already capitally housed by the generous liberality of New York's wealth. May we not confidently believe that the same liberality will, directly or indirectly, be successfully invoked in the cause of Science?